

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Patent Application No. 10/754,390

Applicant: Prasad et al.

Filed: January 9, 2004

TC/AU: 3723

Examiner: Muller, Bryan

Docket No.: 100196 (LVM Reference No.223279)

Customer No.: 29050

**DECLARATION UNDER 37 C.F.R. § 1.131 OF  
ABANESHWAR PRASAD AND RONALD MYERS**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

We, Abaneshwar Prasad and Ronald Myers, do hereby declare:

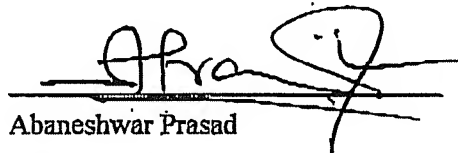
1. We are the inventors of the subject matter disclosed and claimed in the above-identified patent application ("the present invention").
2. The present invention was conceived of prior to June 9, 2003.
3. As merely an example of the conception of the present invention, Exhibit A is attached to this Declaration.
4. Exhibit A is a true and accurate copy notebook pages written before June 9, 2003. Dates and irrelevant information have been redacted from Exhibit A as attached hereto. Exhibit A describes the use of materials having a negative Poisson's Ratio in the manufacturing of polishing pads and subpads.
5. To the best of our knowledge, the preparation and filing of the present application was pursued with diligence from a date prior to June 9, 2003, until the filing date of January 9, 2004. Exhibits B-L are copies of letters and emails concerning the preparation

Application No. 10/754,390

and filing of the present application during that time, which illustrate the aforesaid diligence. Irrelevant information has been redacted from Exhibits B-J as attached hereto.

6. We hereby declare that all statements made herein of our own knowledge are true, that all statements made on information and belief are believed to be true, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: April 13, 2007

  
Abaneshwar Prasad

Date: April 3, 2007

  
Ronald Myers

## Exhibit A

Negative Poisson's (- $\nu$ ) Ratio Materials For CMP Pads and Subpads

Poisson's ratio ( $\nu$ ) of a solid is defined as lateral contraction strain divided by the longitudinal strain. In almost all of polymeric solids and foams  $\nu$  is true and the value lies from 0.1 to 0.5. Rod Lake in his U.S. Patent # 4668557 has disclosed materials with negative  $\nu$  and is also sometimes referred to as anti-rubber, or re-entrant foam or foam with polyhedron cell structures. Conventional foams produce non-linear strain when linear strain is applied. In such foams the ribs or struts forming the cell buckle inwardly (concave cell structure) and expand when compressed. The foams made from  $-\nu$  behave just opposite to rubbers. Such solids or foams become fatter in cross-section when stretched, would be difficult to shear but easy to deform volumetrically. These  $-\nu$  foams have cells of convex shape (e.g. 2-D honeycomb with inverted cell structure), produce linear strain when linear strain is applied. Thus,  $-\nu$  foams become highly compressible but difficult to shear, a property highly desirable for CMP polishing pad (to be discussed later).

Rod Lake describes the method to create such foams of negative Poisson's ratio by modification of an open-cell foam str., heating to above softening point under stretching & then freezing in the strain. We can use similar concept to make Micell, nanocell and subpad foams to create  $-\nu$  materials. Following are the advantages of such materials for CMP application.

- ① Superior resilience pad and subpad that will be helpful to remove edge-on effect during IC polishing. For such use one needs a polishing pad material that poses an elastic force buffer that will eliminate edge-on effect in wafers. For this application it is desirable that the pad and subpad or stack reduce impact forces when wafer hits the pad surface during polishing. The pad structure must be sufficiently compliant for distributed force, yet must be sufficiently rigid that it doesn't compress under a concentrated force. The above argument can be appreciated more if one looks at the mathematical modeling approach given on the next page.

Signed

APR 9

Date

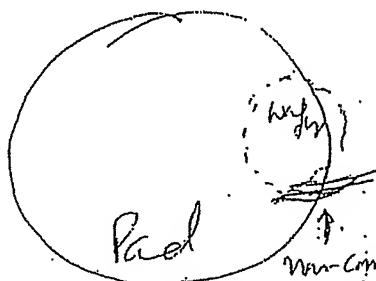
Understood and Witnessed

Signed

Date

0030- 80

## Cabot Microelectronics Corporation Research Notebook



non-compliant  
force on the pad's radius from  
ready to edge-on effect.

Let the  $F$  be the indentation force &  
 $d$  be the maximum displacement upon  
a .200mm wafer heady the 20" Pad.

In that case, Penetration Rigidity Can

be defined as 
$$\frac{F}{d} = \frac{G\gamma}{(1+\nu)} \quad 7$$

Here,  $G$  = Shear modulus,  $\gamma$  = edge radius of wafer.

$\nu$  = Poisson's ratio. For best results, we need  $\frac{F}{d}$  ratio to be small. Then, in eq. 1, everything but constant, a -ve. Poisson's ratio will help in reducing  $F/d$  ratio. Thus, the mathematical model tells us that we need a -ve material for this application.

(2) Since the material of -ve expands laterally when stretched, it provides superior resilience to pad & subpad. will also have better shear distribution. Under shear load due to convex shape as opposed to +ve Poisson's ratio, then -ve foams will be more resilient.

(3) Better shock absorbers having superior strength - Since, the polymer to create -ve foams increases its density as compared to the starting material, the foam is stronger because modulus  $\propto \rho^2$ .

(4) Foams of higher stiffness and better abrasion resistance.

(5) The convex shape of the foam can help in improving slurry flow as well will require less conditioning due to less aggregation & debris in the cell. Then, less aggressive conditioning will be required, thereby increasing the pad life.

(6) Literature claims subpad materials with +ve Poisson's ratio of 0.1 to 0.5. No one has claimed subpad material build of -ve Poisson's ratio. The subpad will have some above drilled benefits.

(7) The stack combination of Pad/subpad of -ve material we can create laminate for to be a superior pad in polishing performance.

Signed

Understood and Witnessed

Signed

Idea for use of materials, especially polymeric foams, having negative Poisson's ratio.

### Negative Poisson's Ratio Materials for use in Manufacturing CMP Pads

This is a disclosure relating to the use of materials having negative Poisson's ratios for the manufacture of CMP pads. Poisson's ratio (PR) is the lateral contraction strain divided by the longitudinal extension strain, and for most materials the PR is a positive value within the range of about 0.1 to 0.5. Materials with negative PRs are known, mainly for inorganic crystals/films but are rare for organic polymers, where they are also referred to as "auxetic", anti-rubber or dilational. Negative PR materials characteristically expand (become thicker) in cross section when stretched. Negative PR polymer foam materials were first made in 1987 (R.S.Lakes, "Foam structures with a negative Poisson's ratio"; Science, 1987, 235, 1038-1040; US Pat. 4,668,557) by subjecting a conventional foam to isotropic volumetric compression, a process that caused a "microbuckling" of the cell structure and the resulting formation of an "inverted" or "re-entrant" cell structure. In this type of material, the "unfolding" of the re-entrant cells gives rise to the negative Poisson's ratio. The characteristic physical/mechanical properties of negative PR foam materials are related to the transmission and reflection, i.e. distribution, of mechanical stresses. Such foams would be much more "resilient" and "shock absorbing" than conventional positive PR foams, and are also more dense, stronger, tougher and more abrasion-resistant than conventional foams. When a negative PR foam is "bulged", the pores tend to open, rather than to close as in a conventional foam (an advantage of "pore opening" in a CMP pad is that the pad can be "self-cleaning", resulting in less frequent pad conditioning and longer pad life.)

Signed

Ronald E. Myers

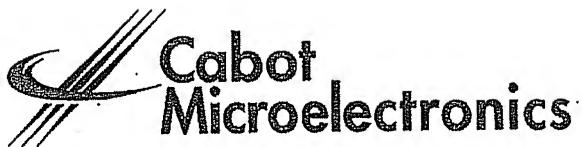
Date

Understood and Witnessed

Signed

R. S. Lakes

## Exhibit B



Phyllis Turner-Brim  
Associate General Counsel, Intellectual Property

Headquarters  
870 N. Commons Drive  
Aurora, IL 60504  
P.O. Box 2026  
Aurora, IL 60507  
630.375.6631  
800.811.2756  
630.375.5539 fax

630.375.5465 direct telephone  
630.499.2654 direct fax  
phyllis\_turner-brim@cabotcmp.com

*PRIVILEGED AND CONFIDENTIAL*

**BY FACSIMILE (312-616-5700)**

June 17, 2003

John Kilyk, Jr., Esq.  
LEYDIG, VOIT & MAYER, LTD.  
Two Prudential Plaza  
Suite 4900  
Chicago, Illinois 60601-6780

**RECEIVED**  
JUN 18 2003

**LEYDIG, VOIT & MAYER**

**Re: New Patent Application  
Cabot Microelectronics Corporation  
CMC Reference No. 100196**

Dear John:

I am forwarding herewith a photocopy of CMC Invention Disclosure No. 100196 entitled "Negative Poisson's Ratio Material for CMP Polishing Pads."

Please begin preparing a patent application describing and claiming the inventions disclosed in this Invention Disclosure.

You may refer to this matter using CMC Reference No. 100196 and the title associated therewith.

Please direct all technical questions concerning this patent application to Abby Prasad, Ron Myers or Ian Wylie.

Your kind attention to this matter is greatly appreciated.

Regards,

A handwritten signature in cursive script that reads "Phyllis T. Turner-Brim".

Phyllis T. Turner-Brim

Enclosure



## Exhibit C

## Calvert, Kristi

---

**From:** Calvert, Kristi  
**Sent:** Wednesday, July 09, 2003 5:49 PM  
**To:** CMC\_Prosecution (E-mail)  
**Cc:** Mariejose Monsalve (E-mail); Kilyk, John Jr.; Borg-Breen, Caryn  
**Subject:** CMC 100196 (LVM 223279)

**Re:** Possible U.S. Patent Application  
"Negative Poisson's Ratio Material for CMP Polishing Pad, Window, and Subpad" (Prasad)  
**CMC Reference:** 100196  
**LVM Reference:** 223279

Dear Phyllis:

In accordance with your request, we have reviewed the disclosure materials regarding the subject invention forwarded to us, and we have conducted a patentability search using various internet databases.

Based on our analysis of the invention disclosure materials and the identified references, we prepared draft patent application claims that define subject matter that we believe to be patentable. We look forward to receiving your comments on the attached draft patent application claims and your further instructions. If you have any questions regarding this matter, please do not hesitate to contact us.

Very truly yours,

LEYDIG, VOIT & MAYER, LTD.

By:

Kristi A. Calvert



223279 draft  
claims.doc

Kristi A. Calvert  
Leydig, Voit & Mayer, Ltd.  
<http://www.leydig.com>  
Two Prudential Plaza, Suite 4900  
Chicago, Illinois 60601-6780  
Tel: (312) 616-5600  
Fax: (312) 616-5700  
email: [kcalvert@leydig.com](mailto:kcalvert@leydig.com)

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## Exhibit D

Calvert, Kristi

---

From: Ian\_Wylie@cabotcmp.com  
Sent: Monday, July 14, 2003 5:21 PM  
To: Calvert, Kristi  
Cc: CMC\_Prosecution@Cabotcmp.com  
Subject: Re: FW: CMC 100196 (LVM 223279)



223279 draft  
claims.doc

Kristi,

I spoke with Abby and we have some feed-back for you.

Please feel free to contact me for further information.

Ian Wylie (IP Specialist, 630-499-2747)

## Exhibit E

Calvert, Kristi

---

From: CMC\_Prosecution@Cabotcmp.com  
Sent: Wednesday, July 16, 2003 4:19 PM  
To: kcalvert@leydig.com  
Cc: Borg-Breen, Caryn; Kilyk, John Jr.; Mariejose Monsalve (E-mail); Ian\_Wylie@cabotcmp.com;  
Steven\_Grumbine@cabotcmp.com  
Subject: Re: CMC 100196 (LVM 223279)



223279 draft  
claims.doc

Kristi,

Please proceed with drafting a patent application for the referenced matter. Thanks ptb

Phyllis T. Turner-Brim  
Associate General Counsel  
Intellectual Property  
Cabot Microelectronics Corporation

## Exhibit F

## Calvert, Kristi

---

**From:** Calvert, Kristi  
**Sent:** Friday, October 03, 2003 12:21 PM  
**To:** CMC\_Prosecution (E-mail)  
**Cc:** Kilyk, John Jr.; Mariejose Monsalve (E-mail); Ian Wylie (E-mail)  
**Subject:** Draft Patent Application (CMC Ref. 100196, LVM Ref. 223279)

New U.S. Patent Application  
"NEGATIVE POISSON'S RATIO MATERIAL-CONTAINING CMP POLISHING PAD" (Prasad et al.)  
CMC Reference: 100196  
LVM Reference: 223279

Dear Phyllis,

In accordance with your instructions, we have drafted an application in connection with the above-identified patent application. An electronic copy of the draft application is attached hereto. We look forward to any comments you may have on the draft patent application.

Best regards,

Kristi



223279app.doc

Kristi A. Calvert  
Leydig, Voit & Mayer, Ltd.  
<http://www.leydig.com>  
Two Prudential Plaza, Suite 4900  
Chicago, Illinois 60601-6780  
Tel: (312) 616-5600  
Fax: (312) 616-5700  
email: [kcalvert@leydig.com](mailto:kcalvert@leydig.com)

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## Exhibit G

## Calvert, Kristi

---

**From:** Ian\_Wylie@cabotcmp.com  
**Sent:** Wednesday, November 05, 2003 4:41 PM  
**To:** Calvert, Kristi  
**Cc:** CMC\_Prosecution@Cabotcmp.com; Claudia\_Cosman@cabotcmp.com; MarieJose\_Monsalve@cabotcmp.com  
**Subject:** Re: FW: CMC 100196 (LVM 223279) - inventor input on draft application



223279 draft  
claims.doc

Kristi,

I am not sure that you are copying me on all the versions of this draft application. If you are not, please try to do so, as it will greatly improve the turn-around time. I have included my previous email to you (from July 14) on the claims because I am not sure whether or not you have considered all of these inventor suggestions in the new draft application. We also have some more input for you on the draft application (and claims), as follows:

Please do not hesitate to contact me for clarification.

Thank-you,

## Exhibit H

## Calvert, Kristi

---

**From:** Calvert, Kristi  
**Sent:** Tuesday, November 25, 2003 10:50 AM  
**To:** 'CMC Prosecution (E-mail)'  
**Cc:** 'Ian Wylie (E-mail)'; 'Mariejose Monsalve (E-mail)'; Kilyk, John Jr...  
**Subject:** Revised Draft Application for CMC Ref. No. 100196 (LVM 223279)

**Re:** Revised Draft U.S. Patent Application  
"Negative Poisson's Ratio Material for CMP Polishing Pad, Window, and Subpad" (Prasad)  
CMC Reference: 100196  
LVM Reference: 223279

Dear Phyllis:

In accordance with your request, we have revised the draft application indicated above. We look forward to receiving your comments on the revised draft application and your further instructions. If you have any questions regarding this matter, please do not hesitate to contact us.

Best regards,  
Kristi



223279app.doc

Kristi A. Calvert  
Leydig, Voit & Mayer, Ltd.  
<http://www.leydig.com>  
Two Prudential Plaza, Suite 4900  
Chicago, Illinois 60601-6780  
Tel: (312) 616-5600  
Fax: (312) 616-5700  
email: [kcalvert@leydig.com](mailto:kcalvert@leydig.com)

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## Exhibit I

**Calvert, Kristi**

---

**From:** Ian\_Wylie@cabotcmp.com  
**Sent:** Tuesday, December 02, 2003 3:07 PM  
**To:** kcalvert@leydig.com  
**Cc:** GMC\_Prosecution@Cabotcmp.com; "Mariejose Monsalve (E-mail)"; Mariejose\_Monsalve  
**Subject:** Re: Revised Draft Application for CMC Ref. No. 100196 (LVM 223279)



223279app.doc

Kristi,

My boss has looked this one over and the only remaining minor improvement that is needed is as follows:

Thanks!

Ian Wylie 630-499-2747

## Exhibit J

## Calvert, Kristi

---

**From:** Calvert, Kristi  
**Sent:** Tuesday, December 02, 2003 4:02 PM  
**To:** 'CMC\_Prosecution (E-mail)'  
**Cc:** 'Mariejose Monsalve (E-mail)'; Kilyk, John Jr.  
**Subject:** Final Draft of Application (CMC Ref. No. 100196, LVM Ref. No. 223279)

**Re:** Draft Application for Final Approval  
"Negative Poisson's Ratio Material-Containing CMP Polishing Pad" (Prasad et al.)  
CMC Reference: 100196  
LVM Reference: 223279

Dear Phyllis:

In accordance with your request, we have finalized the draft application indicated above. We look forward to receiving your comments on the draft application and your further instructions. As always, should you have any questions regarding this matter, please do not hesitate to contact us.

Best regards,  
Kristi



223279app.doc

Kristi A. Calvert  
Leydig, Voit & Mayer, Ltd.  
<http://www.leydig.com>  
Two Prudential Plaza, Suite 4900  
Chicago, Illinois 60601-6780  
Tel: (312) 616-5600  
Fax: (312) 616-5700  
email: [kcalvert@leydig.com](mailto:kcalvert@leydig.com)

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## Exhibit K

Calvert, Kristi

---

**From:** CMC\_Prosecution@Cabotcmp.com  
**Sent:** Monday, January 05, 2004 3:43 PM  
**To:** kcalvert@leydig.com  
**Cc:** Kilyk, John Jr.; 'MarieJose Monsalve (E-mail)'  
**Subject:** Re: Final Draft of Application (CMC Ref. No. 100196, LVM Ref. No. 223 279)



223279app.doc

Kristi,

Please proceed with filing this application as a non-provisional utility application with the USPTO.

Filing activities are to be coordinated with MarieJose as necessary.

Please confirm receipt of these instructions by return email. Thanks ptb

Phyllis T. Turner-Brim  
Associate General Counsel  
Intellectual Property  
Cabot Microelectronics Corporation

## Exhibit L

**Gordon, Jennie**

---

To: 'CMC\_Prosecution (E-mail)'  
Cc: 'MarieJose\_Monsalve (E-mail)'; Kilyk, John Jr.; Calvert, Kristi  
Subject: CMC 100196-PAD; LVM 223279

Re: New U.S. Patent Application  
"NEGATIVE POISSON'S RATIO MATERIAL-CONTAINING CMP POLISHING PAD"  
(Prasad et al.)  
CMC Reference: 100196-PAD  
LVM Reference: 223279

Dear Ms. Turner-Brim:

In accordance with your instructions, we today filed the above-identified patent application with the United States Patent and Trademark Office. Electronic copies of the patent application and PTO Form 1449 are attached below for your records. We understand you will attend to the filing of the Recordation of Assignment by the U.S. Patent and Trademark Office.

Thank you for entrusting this matter to us. If you have any questions or concerns regarding this matter, please do not hesitate to contact us.

Very truly yours,

LEYDIG, VOIT & MAYER, LTD.

By:

Jennifer Gordon  
Patent Paralegal



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223961  
1449Form.doc

Jennifer Gordon  
Patent Paralegal  
Leydig, Voit & Mayer, Ltd.  
<http://www.leydig.com>  
Two Prudential Plaza, Suite 4900  
Chicago, Illinois 60601-6780  
Tel: (312) 616-5600  
Fax: (312) 616-5700  
email: [jgordon@leydig.com](mailto:jgordon@leydig.com)

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